Trial to Validate Environmental DNA (eDNA) as a Survey Method for Fish Ecology Assessment around Offshore Wind Farms

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Ambitious UK Government targets to reach 50GW of operating offshore wind capacity by 2030, is increasing the pressure on the offshore wind farm industry. There is also a move towards demonstrating Biodiversity Net Gain (BNG) and Net Positive Impact (NPI) from marine development activities (Natural England, 2022). These pressures increase the demand for robust and scalable environmental data collection. However, many conventional environmental surveys still rely on costly and time-consuming capture-based techniques (Maiello *et al*. 2022). This is creating a supply chain bottleneck which can result in consenting and development delays. Furthermore, as a greater number of Offshore Wind Farms (OWFs) are being sited in deeper water, it can become more difficult to conduct the required environmental monitoring using existing methods.

Environmental DNA (eDNA) metabarcoding is a technique which can potentially provide an innovative solution to overcome these challenges. All living things leave traces of DNA in the environment (such as mucus, scales, and faeces from fish as they swim in the water column). Water samples for eDNA analysis can be taken without specialized staff using a non-intrusive hand-held device from a wide range of vessels, and from previously inaccessible locations, such as within turbine arrays. Once collected, eDNA can be amplified and sequenced to identify unique genetic sequences. The sequences are then compared to genetic reference databases through a process called bioinformatics to identify species and generate information on the biodiversity of the area sampled.

Natural Power is leading a research project at Blyth Offshore Demonstrator, part funded by the Offshore Wind Growth Partnership (OWGP) and in partnership with EDF Renewables and NatureMetrics. The study will compare data from eDNA sampling with fish catch data from otter trawl surveys conducted simultaneously, as well as with historic data from the site. The main aim of the study is to produce a method for fish ecology eDNA surveys around commercial sites; demonstrating that the technique provides equivalent if not better fish ecological data than the traditional method. Initial results show it also provides data on marine mammals, seabirds, and invertebrates. Should the eDNA methodology be accepted as a viable alternative it would likely lead to a reduction in development costs, delays, survey personnel and environmental impacts. It also has the potential to support ecological targets through the provision of high-quality biodiversity data to assist informed marine planning decisions at both project and regional level.

The first two of four planned surveys are complete, with initial data showing good overlap in the fish species identified, and with 70% more species from the eDNA samples, including fish, invertebrates, seabirds, and marine mammals. The formal results of this study will be published in 2023, however the initial results indicate the potentially important role eDNA may play in future environmental assessment.

References

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Scotland's changing coastal environment: how time series support the Blue Economy Vision

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The Scottish Coastal Observatory (SCObs) has been measuring environmental and biological variables at multiple locations around the Scottish Coast for over 25 years. A combination of temperature, salinity, nutrients, carbonate chemistry, dissolved oxygen, pigments, and plankton communities are collected weekly at selected sites. Two metocean buoys have recently been added to the programme, collecting high frequency meteorological, physical and chemical data which is available in near real time. SCObs data are used to fulfil the Scottish Government's statutory reporting requirement for the Marine Scotland Act (2010), the UK Marine Strategy and the Oslo/Paris Commission (OSPAR) status assessments. SCObs is providing evidence that the physical and chemical properties, and plankton communities of Scottish coastal waters are changing. These changes which have the potential to impact industries that are part of the Blue Economy include; i) a change in the diversity and abundance of plankton life forms with the potential to impact food webs, ii) a decreasing trend in salinity coincident with a catastrophic decline in zooplankton abundance observed at the Loch Ewe site, iii) an increase in the abundance of the shellfish toxin producing diatom *Pseudo-nitzschia* observed in Scalloway, increasing the risk of shellfish harvesting closures, iv) a mismatch between the timing of zooplankton and fish larvae potentially influencing recruitment, and v) dissolution of the shells of shellfish larvae associated with carbonate chemistry. The SCObs dataset also highlights the regional variability of Scotland's coastal environment and how this can impact local marine industries. The conditions of Scotland's marine waters are predicted to change over the coming decades due to multiple pressures such as climate change, ocean acidification and natural variability over yearly to multi-decadal time scales. Time series such as SCObs which identify environmental changes that can impact sustainable use of the marine environment provide important support to the Blue Economy Vision.

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Analysis of greenhouse gas emissions from Scotland's fisheries by fleet and region

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Reducing greenhouse gas emissions from activities across the Blue Economy remains a critical priority in achieving Scotland's climate target to reach net zero greenhouse gas emissions by 2045. Emissions from fisheries are estimated globally to be responsible for 4% of emissions from food productions (Parker et al., 2018). In Scotland, the fishing sector is estimated to contribute 0.3 megatonnes CO2-equivalent (MtCO2e) of the total 40.0 MtCO2e in 2020 (Scottish Government, 2021).

Based on an in depth analysis of Scotland's pelagic fishing fleet, vessel fuel consumption is the main activity contributing to these emissions (Sandison et al., 2020). Recent work by Marine Scotland and others to improve the estimation of greenhouse gas emissions for all the fleet segments of the Scottish fishing sector has shown the distribution of emissions is skewed to certain segments. This work has also highlighted that consideration of overall greenhouse gas emissions, as well as the emissions per kilogram landed should be considered carefully in decision making. These analyses have all so far focused on fuel consumption, and have not explicitly considered interaction with carbon stored in sea bed sediments and biota.

Here, we present an analysis of the greenhouse gas emissions from the entire Scottish fleet, both by fleet segment and by region. Greenhouse gas emissions for certain fleet segments are also associated with specific ports, based on the current fleet's distribution.

The results of this analysis will inform engagement between the fishing sector, ports & harbours and decision makers.

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